NI PXI/PCI-5114 Specifications

8-Bit 250 MS/s Digitizer

This document lists the specifications for the NI PXI/PCI-5114 (NI 5114) high-speed digitizer. Unless otherwise noted, these specifications are valid for the following conditions:

- All filter settings
- All impedance selections
- Sample clock set to 250 MS/s

Typical values are representative of an average unit operating at room temperature. Specifications are subject to change without notice. For the most recent NI 5114 specifications, visit `ni.com/manuals`.

To access the NI 5114 documentation, including the *NI High-Speed Digitizers Getting Started Guide*, which contains functional descriptions of the NI 5114 signals, navigate to **Start»All Programs»National Instruments»NI-SCOPE»Documentation**.

⚠ **Hot Surface**   If the NI 5114 has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5114 to cool before removing it from the PXI chassis or PC. Refer to the *Environment* section for operating temperatures of this device.

Contents

NATIONAL INSTRUMENTS™

Vertical

Analog Input (Channel 0 and Channel 1)

Specification	Value	Comments
Number of Channels	Two (simultaneously sampled)	—
Connector	BNC	—
Impedance and Coupling		
Input Impedance	50 Ω ±1.5% 1 MΩ ±1% in parallel with a typical capacitance of 26 pF	Software selectable
Input Coupling	AC, DC, GND	AC coupling available on 1 MΩ only

Specification	Value				Comments
Voltage Levels					
Full Scale (FS) Input Range and Programmable Vertical Offset	50 Ω		1 MΩ		—
	Range (V_{pk-pk})	Vertical Offset Range (V)	Range (V_{pk-pk})	Vertical Offset Range (V)	
	0.04	±0.8	0.04	±0.8	
	0.1	±0.8	0.1	±0.8	
	0.2	±0.8	0.2	±0.8	
	0.4	±0.8	0.4	±0.8	
	1	±6.5	1.0	±8.0	
	2	±6.0	2.0	±8.0	
	4	±5.0	4.0	±8.0	
	10	±2.0	10	±30	
			20	±25	
			40	±15	
Maximum Input Overload	50 Ω		1 MΩ		—
	7 V_{rms} with |Peaks| ≤10 V		|Peaks| ≤35 V		
Accuracy					
Resolution	8 bits				—
DC Accuracy (Programmable Vertical Offset = 0 V)	**NI PXI-5114**: ±(1.5% of Input + 0.3% of FS + 200 µV) **NI PCI-5114**: ±(1.5% of Input + 0.3% of FS + 280 µV)				Within ±5 °C of self-calibration temperature
Programmable Vertical Offset Accuracy	± 2% of offset setting				Within ±5 °C of self-calibration temperature
DC Drift	±(0.03% of Input + 0.06% of FS + 40 µV) per °C				—
Crosstalk, Typical	≤–60 dB at 10 MHz ≤–45 dB at 100 MHz				CH 0 to/from CH 1, External Trigger to CH 0 or CH 1

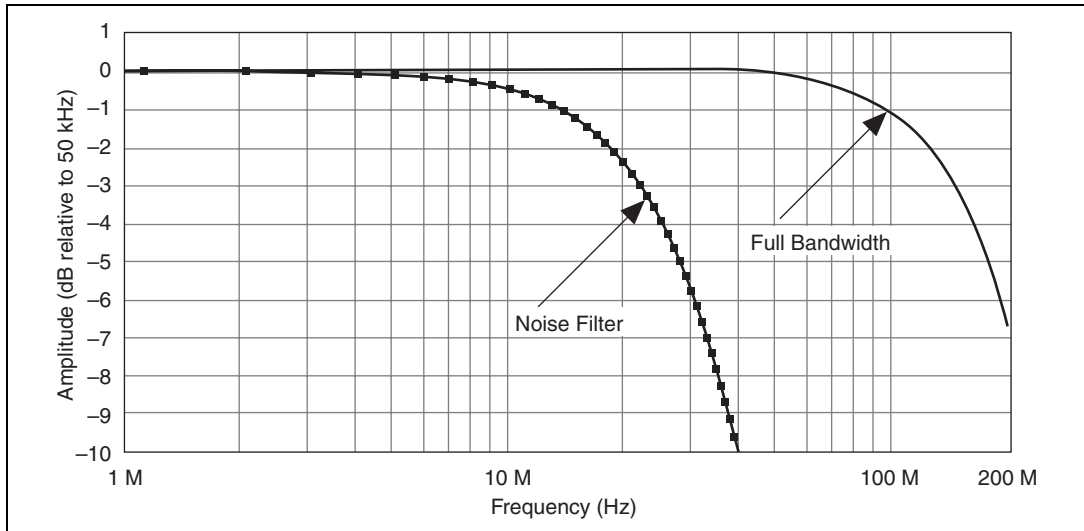| Specification	Value			Comments
Bandwidth and Transient Response				
Bandwidth (–3 dB)	Range ($V_{pk\text{-}pk}$)	Bandwidth	Rise/Fall Time, Typical	—
	All ranges except 0.04	125 MHz	2.8 ns	
	0.04	100 MHz	3.5 ns	
Bandwidth Limit Filter	20 MHz Noise Filter			—
AC Coupling* Cutoff (–3 dB), Typical	12 Hz			*AC coupling available on 1 MΩ only
Passband Flatness	±1 dB up to 50 MHz			Referenced to 50 kHz Bandwidth limit filter off

Figure 1. NI 5114 Frequency Response (Typical)

Specification	Value		Comments
Spectral Characteristics			
Spurious-Free Dynamic Range with Harmonics (SFDR), Typical	Range (V_{pk-pk})		10 MHz, −1 dBFS input signal
	All ranges except 0.04	0.04	Includes the 2nd through the 5th harmonics
	58 dBc	58 dBc	
Total Harmonic Distortion (THD), Typical	−58 dBc	−58 dBc	
Effective Number of Bits (ENOB), Calculated*	7.2	6.2	Measured from DC to 125 MHz 20 MHz bandwidth limit filter off
Signal to Noise and Distortion (SINAD), Typical	44 dB	38 dB	

RMS Noise	Range (V_{pk-pk})	20 MHz Filter On	20 MHz Filter Off	50 Ω terminator connected to input
	All ranges except 0.04	0.28% FS	0.28% FS	
	0.04	0.28% FS	0.45% FS	

*$ENOB = \log_2(\text{sinad}) - \frac{1}{2}\log_2(1.5) - \log_2(A/V)$

where

   sinad = the linear representation of SINAD
   A = amplitude of the supplied sine wave during the test
   V = (peak) full-scale range of the waveform recorder input

Refer to *1057-1994 IEEE Standard for Digitizing Waveform Recorders* for information on equation derivation.

Horizontal

Sample Clock

Specification	Value		Comments
Sources	Internal, Onboard Clock (internal VCXO)* External, CLK IN (front panel SMB connector)		* Internal Sample Clock is locked to the Reference Clock or derived from the onboard VCXO
Onboard Clock (Internal VCXO)			
Sample Rate Range	Real-Time Sampling (Single Shot)	Random Interleaved Sampling (RIS)	* Divide by n decimation used for all rates less than 250 MS/s For more information about Sample Clock and decimation, refer to the *NI High-Speed Digitizers Help*.
	3.815 kS/s to 250MS/s*	250 MS/s to 5 GS/s in increments of 250 MS/s	
Timebase Frequency	250 MHz		When not using External Sample Clock
Timebase Accuracy	Not Phase-Locked to Reference Clock	Phase-Locked to Reference Clock	—
	±25 ppm	Equal to the Reference Clock accuracy	
Sample Clock Delay Range	±1 Sample Clock period		—
Sample Clock Delay Resolution	≤20 ps		—

Specification	Value	Comments
External Sample Clock		
Sources	CLK IN (front panel SMB connector)	—
Frequency Range	50 MHz to 250 MHz	Divide by n decimation available where $1 \le n \le 65{,}535$ For more information about Sample Clock and decimation, refer to the *NI High-Speed Digitizers Help*.
Duty Cycle Tolerance	45% to 55%	—

Phase-Locked Loop (PLL) Reference Clock

Specification	Value	
Sources	NI PXI-5114	NI PCI-5114
	PXI_CLK10 (backplane connector) CLK IN (front panel SMB connector)	RTSI 7 CLK IN (front panel SMB connector)
Frequency Range	1 MHz to 20 MHz in 1 MHz increments Default of 10 MHz The PLL Reference Clock frequency must be accurate to ±50 ppm	
Duty Cycle Tolerance	45% to 55%	
Exported Reference Clock Destinations	NI PXI-5114	NI PCI-5114
	PFI <0..1> (front panel 9-pin mini-circular DIN connector) PXI_Trig <0..7> (backplane connector)	PFI <0..1> (front panel 9-pin mini-circular DIN connector) RTSI <0..7>

CLK IN (Sample Clock and Reference Clock Input, Front Panel Connector)

Specification	Value
Input Voltage Range	Sine wave: 0.65 $V_{pk\text{-}pk}$ to 2.8 $V_{pk\text{-}pk}$ (0 dBm to 13 dBm) Square wave: 0.2 $V_{pk\text{-}pk}$ to 2.8 $V_{pk\text{-}pk}$
Maximum Input Overload	7 V_{rms} with |Peaks| ≤10 V
Impedance	50 Ω
Coupling	AC

Trigger

Reference (Stop) Trigger

Specification	Value		Comments
Trigger Types and Sources	Types	Sources	Refer to the following sections and to *NI High-Speed Digitizers Help* for more information.
	Edge, Window, Hysteresis, Video, Digital, Immediate, and Software	CH 0, CH 1, TRIG, PXI_Trig<0..6>, PFI <0..1>, PXI Star Trigger, RTSI<0..6>, and Software	
Time Resolution	TDC	Onboard Clock	External Clock	TDC = Time to Digital Conversion Circuit
	On	40 ps	N/A	
	Off	4 ns	External Clock Period	
Rearm Time	TDC	Rearm Time	Holdoff set to 0
	On	10 µs	
	Off	2 µs	
Holdoff	From Rearm Time up to [(2^{35} – 1) × (Sample Clock Period)]		—
Trigger Delay	From 0 up to [(2^{35} – 1) – *posttrigger samples*] × (1/*sample rate*), in seconds		—

Specification	Value		Comments
Analog Trigger (Edge, Window, and Hysteresis Trigger Types)			
Sources	CH 0 (front panel BNC connector) CH 1 (front panel BNC connector) TRIG (front panel BNC connector)		—
Trigger Level Resolution	8 bits (1 in 256)		
Trigger Level Range	CH 0, CH 1	TRIG (External Trigger)	—
	100% FS	±5 V	
Edge Trigger Sensitivity	5% FS up to 100 MHz	0.5 V_{pk-pk} up to 100 MHz	
Level Accuracy, Typical	±5% FS up to 10 MHz	±0.5 V up to 10 MHz	
Jitter	≤65 ps rms		—
Trigger Filters	Low Frequency (LF) Reject	High Frequency (HF) Reject	—
	50 kHz	50 kHz	
Digital Trigger (Digital Trigger Type)			
Sources	NI PXI-5114	NI PCI-5114	—
	PXI_Trig <0..6> (backplane connector) PFI <0..1> (front panel SMB connector) PXI Star Trigger (backplane connector)	RTSI <0..6> PFI <0..1> (front panel SMB connector)	
Video Trigger (Video Trigger Type)			
Sources	CH 0 (front panel BNC connector) CH 1 (front panel BNC connector) TRIG (front panel BNC connector)		—

Specification	Value	Comments
Types	Specific Line Any Line Specific Field	—
Standards	SDTV: M-NTSC, B/G-PAL, SECAM, M-PAL EDTV: 480i/59.94 fps, 480i/60 fps, 480p/59.94 Fps, 480p/60 Fps, 576i/50 fps, 576p/50 Fps HDTV: 720p/50 Fps, 720p/59.94 Fps, 720p/60 Fps, 1080i/50 fps, 1080i/59.94 fps, 1080i/60 fps, 1080p/24 Fps	fps = fields per second Fps = Frames per second

TRIG (External Trigger, Front Panel Connector)

Specification	Value
Connector	BNC
Impedance	1 MΩ in parallel with 22 pF
Coupling	AC, DC
AC-Coupling Cutoff (–3 dB)	12 Hz
Input Voltage Range	±5 V
Maximum Input Overload	|Peaks| ≤42 V

PFI 0 and PFI 1 (Programmable Function Interface, AUX Front Panel Connectors)

Specification	Value
Connector	9-pin mini-circular DIN
Direction	Bi-directional
As an Input (Trigger)	
Destinations	Start Trigger (Acquisition Arm)
	Reference (Stop) Trigger
	Arm Reference Trigger
	Advance Trigger
Input Impedance	150 kΩ
V_{IH}	2.0 V
V_{IL}	0.8 V
Maximum Input Overload	–0.5 V, 5.5 V
Maximum Frequency	25 MHz
As an Output (Event)	
Sources	Start Trigger (Acquisition Arm)
	Reference (Stop) Trigger
	End of Record
	Done (End of Acquisition)
	Probe Compensation (1 kHz, 50% duty cycle square wave, PFI 1 only)
Output Impedance	50 Ω
Logic Type	3.3 V CMOS
Maximum Drive Current	±24 mA
Maximum Frequency	25 MHz

TClk Specifications

National Instruments TClk synchronization method and the NI-TClk driver are used to align the sample clocks on any number of SMC-based modules in a chassis. For more information about TClk synchronization, refer to the *NI-TClk Synchronization Help*, which is located within the *NI High-Speed Digitizers Help*.

- Specifications are valid for any number of modules installed in one NI PXI-1042 chassis.

- All parameters set to identical values for each SMC-based module.

- Sample Clock set to 250 MS/s and all filters are disabled.

- For other configurations, including multichassis systems, contact NI Technical Support at ni.com/support.

📝 **Note** Although you can use NI-TClk to synchronize nonidentical modules, these specifications apply only to synchronizing identical modules.

Specification	Value	Comments
Intermodule SMC Synchronization Using NI-TClk for Identical Modules (Typical)		
Skew	500 ps	Caused by clock and analog path delay differences No manual adjustment performed
Skew After Manual Adjustment	<20 ps	For information about manual adjustment, refer to the *Synchronization Repeatability Optimization* topic in the *NI-TClk Synchronization Help*. For additional help with the adjustment process, contact NI Technical Support at ni.com/support.
Sample Clock Adjustment Resolution	<20 ps	—

Waveform Specifications

Specification	Value		Comments
Onboard Memory Size	8 MB per Channel Standard	8 megasamples per channel	—
	64 MB per Channel Option	64 megasamples per channel	
	256 MB per Channel Option	256 megasamples per channel	
Minimum Record Length	1 Sample		—
Number of Pretrigger Samples	Zero up to full Record Length		Single-record mode and multiple-record mode
Number of Posttrigger Samples	Zero up to full Record Length		Single-record mode and multiple-record mode
Maximum Number of Records in Onboard Memory	8 MB/channel	32,768	* It is possible to exceed these numbers if you fetch records while acquiring data. For more information, refer to the *NI High-Speed Digitizers Help*.
	64 MB/channel	100,000*	
	256 MB/channel	100,000*	
Allocated Onboard Memory per Record	(*Record Length* $\times$ 1 byte/S) + 240 bytes, rounded up to next multiple of 128 bytes or 256 bytes, whichever is greater		—

Calibration

Specification	Value
Self-Calibration	Self-calibration is done on software command. The calibration corrects for gain, offset, compensated 1 MΩ attenuator, triggering, and timing adjustment errors for all input ranges.
External Calibration (Factory Calibration)	The external calibration calibrates the VCXO, gain, and the voltage reference. Appropriate constants are stored in nonvolatile memory.
Interval for External Calibration	2 years
Warm-Up Time	15 minutes

Power

Specification	Typical Value	
	NI PXI-5114	NI PCI-5114
+3.3 VDC	840 mA	1.6 A
+5 VDC	1.1 A	1.7 A
+12 VDC	250 mA	45 mA
–12 VDC	170 mA	—
Total Power	13.32 W	14.32 W

Software

Specification	Value
Driver Software	**NI PXI-5114**: NI-SCOPE 2.9 or later
	NI PCI-5114: NI-SCOPE 3.1 or later
	NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the NI 5114. NI-SCOPE provides application programming interfaces for many development environments.
Application Software	NI-SCOPE provides programming interfaces, documentation, and examples for the following application development environments:
	• LabVIEW
	• LabWindows™/CVI™
	• Measurement Studio
	• Microsoft Visual C/C++
	• Microsoft Visual Basic
Interactive Soft Front Panel and Configuration	The Scope Soft Front Panel 2.3 or later supports interactive control of the NI 5114. The Scope Soft Front Panel is included on the NI-SCOPE CD.
	National Instruments Measurement & Automation Explorer (MAX) also provides interactive configuration and test tools for the NI 5114. MAX is included on the NI-SCOPE CD.

Environment

NI PXI-5114

📝 **Note** To ensure that the NI PXI-5114 cools effectively, follow the guidelines in the *Maintain Forced Air Cooling Note to Users* included in the NI PXI-5114 kit. The NI PXI-5114 is intended for indoor use only.

Specification	Value
Operating Temperature	0 ºC to +55 ºC in all NI PXI chassis except the following:
	0 ºC to +45 ºC when installed in an NI PXI-1000/B or PXI-101*x* chassis
	Meets IEC-60068-2-1 and IEC-60068-2-2
Storage Temperature	−40 ºC to +71 ºC
	Meets IEC-60068-2-1 and IEC-60068-2-2
Operating Relative Humidity	10% to 90%, noncondensing
	Meets IEC-60068-2-56
Storage Relative Humidity	5% to 95%, noncondensing
	Meets IEC-60068-2-56
Operating Shock	30 g, half-sine, 11 ms pulse
	Meets IEC-60068-2-27
	Test profile developed in accordance with MIL-PRF-28800F
Storage Shock	50 g, half-sine, 11 ms pulse
	Meets IEC-60068-2-27
	Test profile developed in accordance with MIL-PRF-28800F
Operating Vibration	5 Hz to 500 Hz, 0.31 g_{rms}
	Meets IEC-60068-2-64
Storage Vibration	5 Hz to 500 Hz, 2.46 g_{rms}
	Meets IEC-60068-2-64
	Test profile exceeds requirements of MIL-PRF-28800F, Class B
Altitude	2,000 m maximum (at 25 °C ambient temperature)
Pollution Degree	2

NI PCI-5114

✎ **Note** To ensure that the NI PCI-5114 cools effectively, make sure that the chassis in which it is used has active cooling that provides at least some airflow across the PCI card cage. To maximize airflow and extend the life of the device, leave any adjacent PCI slots empty. Refer to the *Maintain Forced Air Cooling Note to Users* included in the NI PCI-5114 kit for important cooling information. The NI PCI-5114 is intended for indoor use only.

Specification	Value
Operating Temperature	0 ºC to +45 ºC Meets IEC-60068-2-1 and IEC-60068-2-2
Storage Temperature	–40 ºC to +71 ºC Meets IEC-60068-2-1 and IEC-60068-2-2
Operating Relative Humidity	10% to 90%, noncondensing Meets IEC-60068-2-56
Storage Relative Humidity	5% to 95%, noncondensing Meets IEC-60068-2-56
Storage Shock	50 g, half-sine, 11 ms pulse Meets IEC-60068-2-27 Test profile developed in accordance with MIL-PRF-28800F
Storage Vibration	5 Hz to 500 Hz, 2.46 g_{rms} Meets IEC-60068-2-64 Test profile exceeds requirements of MIL-PRF-28800F, Class B
Altitude	2,000 m maximum (at 25 °C ambient temperature)
Pollution Degree	2

Safety, Electromagnetic Compatibility, and CE Compliance

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device with RG223/U or equivalent shielded cable. Operate according to product documentation

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as any other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit ni.com/environment/weee.htm.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。
关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。
(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)
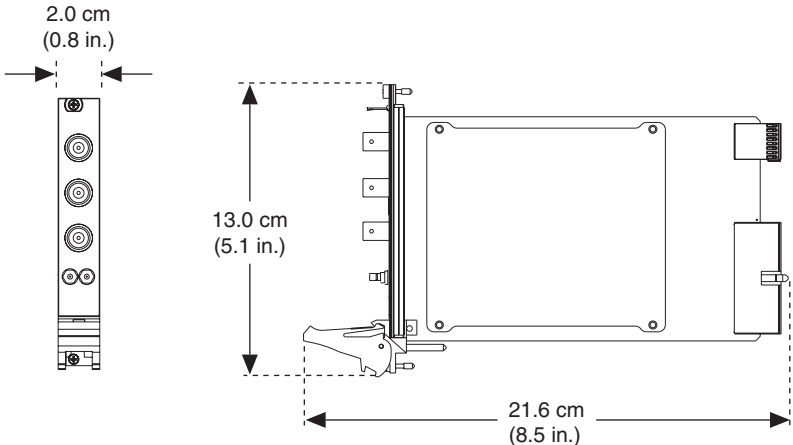
Physical

Front Panel Connectors

Label	Function	Connector Type	Comments
CH 0	Analog Input	BNC female	—
CH 1	Analog Input	BNC female	
TRIG	External Trigger	BNC female	
CLK IN	Sample Clock Input and Reference Clock Input	SMB jack	
AUX I/O	PFI 0, PFI 1	9-pin mini-circular DIN	

NI PXI-5114 Front Panel Indicators		
Label	Function	For more information, refer to the *NI High-Speed Digitizers Help*.
ACCESS	The ACCESS LED indicates the status of the PCI bus and the interface from the NI PXI-5114 to the controller.	
ACTIVE	The ACTIVE LED indicates the status of the onboard acquisition hardware of the NI PXI-5114.	

Dimensions and Weight

NI PXI-5114	
Dimensions	3U, One slot, PXI/cPCI Module $21.6 \times 2.0 \times 13.0$ cm $(8.5 \times 0.8 \times 5.1$ in.)
Weight	455 g (16 oz)

NI PCI-5114	
Dimensions	35.5 × 2.0 × 11.3 cm (14.0 × 0.8 × 4.4 in.) 2.0 cm (0.8 in.) 11.3 cm (4.4 in.) 35.5 cm (14.0 in.)
Weight	421 g (14.8 oz)

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At `ni.com/support` you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting `ni.com/certification`. If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 1800 300 800, Austria 43 662 457990-0,
Belgium 32 (0) 2 757 0020, Brazil 55 11 3262 3599,
Canada 800 433 3488, China 86 21 5050 9800,
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 358 (0) 9 725 72511, France 01 57 66 24 24,
Germany 49 89 7413130, India 91 80 41190000, Israel 972 3 6393737,
Italy 39 02 413091, Japan 81 3 5472 2970, Korea 82 02 3451 3400,
Lebanon 961 (0) 1 33 28 28, Malaysia 1800 887710,
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New Zealand 0800 553 322, Norway 47 (0) 66 90 76 60,
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